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The outbreak of COVID-19 pandemic and its impact on stock market volatility: Evidence from a worst-affected economy

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This paper empirically investigates the impact of COVID-19 on the volatility of stock prices in India with the help of a generalized autoregressive conditional heteroscedasticity model. Daily closing prices of stock indices, Nifty and Sensex from September 3, 2019 to July 10, 2020 has been used for the analysis. Further, the study has been attempted to make a comparison of stock price return in pre-COVID-19 and during COVID-19 situation. Findings reveal that the stock market in India has experienced volatility during the pandemic period. While comparing the result during COVID period with that of the pre-COVID, we found that the return on the indices is higher in the pre-COVID-19 period than during COVID-19.

1 | INTRODUCTION

The rapid spread of the unprecedented COVID-19 pandemic has put the world in jeopardy and changed the global outlook unexpectedly. Initially, the SARS-CoV-2 virus, which caused the COVID-19 outbreak triggered in Wuhan city, Hubei province of China in December 2019, and with time it spread all over the globe. This pandemic is not only a global health emergency but also a significant global economic downturn too. As many countries adopt strict quarantine policies to fight the unseen pandemic, their economic activities are suddenly shut down. Transports being limited and even restricted among countries have slowed down global economic activities. Most importantly, consumers and firms have prevented their usual consumption patterns due to the creation of panic among them and created market abnormality. Uncertainty and risk created due to this pandemic, causing significant economic impact all over the globe affecting both advanced and emerging economies such as the United States, Spain, Italy, Brazil, and India. In this context, the financial market has responded with dramatic movement and adversely affected. Economic turmoil associated with COVID-19 has affected the financial market severely which includes both stock and bond markets. Due to this pandemic, there is a large fall in the price of oil and a large increase in the price of gold. Firzli (2020), refers to this pandemic as "the greater financial crisis." In many countries, businesses are highly indebted, weak companies are further destabilized, and corporate debt stands at a very high level. The global financial market risk has increased substantially in response to the pandemic (Zhang et al., 2020). Investors are suffering sufficient

losses due to fear and uncertainty. For example, due to the impact of this pandemic, the global stock market has struck out about US$6 trillion in 1 week from 24 to 28 February (Ozili & Arun, 2020). The market value of standard & poor (S&P) 500 indexes declined to 30% since the COVID-19 outbreak. According to Azimili (2020) increased uncertainty affects the required rate of return and thus the current market value of stocks.

Although there is limited current literature related to the impact of COVID-19 on the financial market, the existing empirical studies have provided an exciting result. Baret et al. (2020), in their research on financial markets and banks, have found that there is a fall in the share of oil, equity, and bonds throughout the world as a result of the COVID-19 pandemic. Social distancing measures adversely affected the productivity of the companies and brought about a decrease in revenue, higher operating cost, and also cash flow challenges to the companies. In Europe, the Financial Times Stock Exchange 100 index witnessed a sharp 1-day fall since 1987 (BBC News, 2020). Igwe (2020) is of the view that the shock from this pandemic can increase the volatility that can negatively affect the economic and financial system of every country. Most of the developed and developing countries' financial markets are adversely affected by this unexpected pandemic. The leading economy of the world, the US stock market hit the circuit breaker mechanism four times in 10 days in March 2020 (Zhang et al., 2020). The stock market of Europe and Asia has also jumped. United Kingdom's leading index FTSE has fallen more than 10% on March 12, 2020 (Zhang et al., 2020). Vishnoi and Mookerjee (2020) observed that the stock market in Japan had

dropped more than 20% in December 2019. The stock market of Spain, Hong Kong, and China also declined to 25.1, 14.75, and 12.1% in their price from March 8, 2020 to March 18, 2020 (Shehzad et al., 2020). In his study, also found a harmful impact of the COVID-19 on stock returns of the S&P 500 and an inconsequential impact on the Nasdaq composite index. Georgieva (2020) pointed out that the COVID-19 pandemic brought the entire globe near to financial crises more hazardous than Global Crises 2007–2008.

Gradually the worst effect of the pandemic spread to the emerging economy too. If we consider the financial market of the emerging economy a gloomy picture caught our eyes as this economy is worst-hit by the collapse of oil prices. The outbreak of the COVID-19 pandemic makes this picture more critical. The top leading emerging economies such as Brazil, Russia, and Mexico gradually moved toward hard mobility restrictions that will bring down the emerging economies to a recession of 1% in 2020 (Herfero,). In South Korea, the Coronavirus disease caused KOSPI to drop below 1,600 in their history after 10 years (So, 2020). In China, higher uncertainty due to COVID-19 results in greater volatility of stock return (Leduc & Liu, 2020). The government of India announced Janata Curfew on March 22, 2020 and lockdown policy to maintain social distancing practice to slow down the outbreaks from March 24, 2020. As the government announced such a lockdown policy, various economic activities have been stopped suddenly. The financial market of India is witnessed sharp volatility as a result of the disruption of the global market (Raja Ram, 2020). As a result of the fall out in the global financial market, the Indian stock market also witnesses sharp volatility. It has also borne the brunt of the COVID-19 pandemic.

There are two major stock indices in India—Bombay Stock Exchange (BSE), Sensex, and National Stock Exchange (NSE), Nifty. If we look at the Bombay Stock Exchange there is a drop in the Sensex index to 13.2% on March 23, 2020. It was the highest single they fall after the news of the Harshad Mehta Scam, April 28, 1991 (Mandal, 2020). Similarly, Nifty has also declined to almost 29% during this period. Some economists have considered the impact of COVID-19 on the Indian stock market as a "black swan event," that is, the occurrence of a highly unanticipated event with an extremely bad impact. Due to the lockdown policy adopted by the government, the factories have reduced the size of their labor force as well as production level which disrupted the supply chain. Again, because of the uncertainty prevailing among mankind, people also reduce their consumption habits leading to demand-side shock. Studies have also found that the entire previous pandemic had affected only the demand chain. But this COVID-19 pandemic has affected both the demand chain and supply chain.

Despite the several literatures on the impact of COVID-19 on the stock market of the entire economy, there is limited study on it especially in the case of an emerging economy. To shed light on this aspect, this paper attempts to investigate the impact of COVID-19 on the two important stock market of India. Glosten–Jagannathan–-Runkle (GJR) generalized autoregressive conditional heteroscedasticity (GJR GARCH) model is used to make the study

more significant in terms of volatility in stock index prices due to the outbreak of the pandemic and lockdown policy adopted by the Indian Government. Major findings of the study reveal the volatile nature of BSE Sensex and NSE Nifty, the two prominent stock market of India.

This paper is organized as follows. Section 1 starts with an introduction, Section 2 represents a literature review, Section 3 describes the sources of data and methodology, Section 4 shows results and discussion, and Section 5 ends with the conclusion.

2 | LITERATURE REVIEW

The impact of COVID-19 on the financial market as well as the stock market has been subject to many empirical studies both in advanced and emerging economies. Existing literature found diverse results in these regards. Ozili and Arun (2020) have conducted an empirical study on the effect of social distancing policy that was adopted to prevent the spread of the Coronavirus, based on four continents: North America, Africa, Asia, and Europe. The study found that 30 days of social distancing policy or lockdown hurts the economy through its negative impact on stock prices. Azimili (2020), also researched on understanding the impact of coronavirus on the degree and structure of risk-return dependence in the United States using quantile regression. The results indicate that following the COVID-19 outbreak the degree of dependence between returns and market portfolio has raised in the higher quantiles that lowering the benefits of diversification. The author also studied the GSIC and stock return relationship and found that the GSIC return relationship revealed an asymmetric pattern, lower tails influenced negatively almost twice as compared to the upper tails. Shehzad et al. (2020) conducted a study to analyze the nonlinear behavior of the financial market of the United States, Italy, Japan, and China market return by applying the asymmetric power GARCH model. The study confirmed that COVID-19 harm the stock returns of the S&P 500. However, it revealed an inconsequential impact on the Nasdaq composite index. An empirical study conducted by Cepoi (2020) on the relationship between COVID-19 related news and stock market returns across the topmost affected countries. By employing a panel quantile regression this study found that the stock market presents asymmetry dependence on COVID-19 related information. Osagie et al. (2020) by applying quadratic GARCH and exponential GARCH models with dummy variables found that the COVID-19 hurts the stock returns in Nigeria and recommended that a stable political environment, incentive to indigenous companies, diversification of economy, and flexible exchange rate regime be implemented to improve the financial market. Baker (2020), in his study, found that there is a dramatic fall in oil prices by 70–80%. It is severe than the financial crisis of 2008/2009. This is a serious issue for the economy as the country is highly dependent on oil revenue. There is a huge gap between the depreciated exchange rate, that is, 20% and the fall in oil prices, that is, 70–80%. According to Herrero (2020), the third wave of the COVID-19 pandemic has hit the emerging economy worst resulting decrease in business activities. This unprecedented shock increases the risk-averse nature which increases

the financial cost. Latin America is affected worst because of its much dependency on external financing. Due to the restriction on transport, export has declined. Restriction in the international movement has hampered the tourism sector leading to a fall in revenue. Hyun-Jung (2020) has made a study on the stock market of South Korea, another leading country of the emerging economies. In his analysis, it was found that the economy has shown a roller-coaster ride. The monthly export shows a downtrend in January, improved in February, then again dipped down in March and June. The country's export volume has come down to 11.2% point in comparison to the previous year. Topcu and Gulal (2020) have made regional classification of the impact of COVID-19 on the stock market of emerging economy. Their findings reveal that the impact of the outbreak has been the highest in Asian emerging markets whereas European emerging markets have experienced the lowest. The emerging market economies face a credit crunch, also referred to as capital flows (Ahmed et al., 2020). Goldberg and Reed (2020) discussed the negative effect of COVID-19 on the trade of emerging economy. Consequently, the interest rate on emerging market sovereign debt spiked. Frankel (2020) analyzed the economic effect of the pandemic on the emerging economy. COVID-19 has reduced the revenue of those economies by restricting export, tourism receipts, and remittances of migrant workers. Raja Ram (2020) in his study has found that COVID-19 crashes the entire global share. Indian stock market also experienced sharp volatility due to the collapse of the global financial market. Again fall in foreign portfolio investments also reduces the return of the Indian stock market. By analyzing the history of all unexpected events the author has considered COVID-19 also a "black swan" event. He has further analyzed the history of the crash and recovery of the Indian stock market and concluded that the economist cannot predict the recovery of the economy until a stable public health system. Ravi (2020) has compared the pre-COVID-19 and during COVID-19 situation of the Indian stock market. His findings revealed that before COVID-19, that is, at the beginning of January, trade of NSE and BSE were at their highest levels hitting peaks of 12,362 and 42,273, respectively showing favorable stock market conditions. After the outbreak of the COVID-19, the stock market came under fear as BSE Sensex and NSE Nifty fell by 38%. It leads to a 27.31% loss of the total stock market from the beginning of this year. The stock of some other sectors such as hospitality, tourism, and entertainment has been dropped by more than 40% due to transport restrictions. Mandal (2020) has rigorously analyzed the agony of the deadly pandemic on the Indian stock market. Findings reveal that BSE Sensex has witnessed the biggest single-day fall of 13.2% that has surpassed the infamous fall of April 28, 1992. Nifty also has a steep dive of 29%, overtaking the disaster of 1992. As people have compressed their consumption only to necessary products only the FMCG Company has shown a positive return whereas other companies face a sharp decline (Rakshit & Basistha, 2020).

There is various literature available on the impact of COVID-19 on different sectors such as health, agriculture, industry, trade, and commerce, but a limited specific study has been conducted on its impact on the stock market of the emerging economy. The stock market plays an important role in the economy. As India is one of the dominant parts of the emerging economy, this paper tries to interpret the impact of COVID-19 on the Indian stock market. GJR GARCH is an efficient model to test the volatility of BSE and NSE, the two major stock market of India. Besides, there are very few literature that compares the return of the stock market before and during the COVID-19 situation. Accordingly, our study has also made an attempt to compare the returns of both the stock market considering those two mentioned time frames.

3 | DATA AND METHODOLOGY

The study is based on secondary sources of data. Data on daily closing prices of indices Nifty and Sensex have been collected from the official site of BSE and NSE (https://in.finance.yahoo.com/). Data are collected from September 3, 2019 to July 10, 2020 including both the period before and during COVID-19. The time period from September 3, 2019 to January 29, 2020 is considered as before the COVID-19 phase and January 30, 2020 to October 6, 2020 as during COVID-19, that is, the first 5 months are taken as before COVID-19 and the next 5 months as during COVID-19 time frame for the study (https://www.statista.com/). The first positive case of India was found on January 30, 2020. Data on COVID-19 positive cases are collected from the report of the Ministry of Health and Family Welfare, Government of India (https://www.mohfw.gov.in/). Hence, for this study, the period before this date is considered as the pre-COVID-19 era and the period after this date is considered as during the COVID-19 era.

In this paper, the closing price of BSE and NSE has been considered for analyzing the volatility of the stock market. In the estimations, we take the natural logarithm of each price data to reduce the observed skewness in the stock price data distribution.

The return of both BSE and NSE has been also calculated to investigate the scenario of change in stock price return during pre-COVID and the COVID period. To calculate the return, the following formula has been used (Osagie et al., 2020):

$$R_t = lnP_t - lnP_{t-1}. \tag{1}$$

Here, R_t, P_t, and P_{t-1} represent the day-wise return, the closing price of the stock at time t, and the previous day's closing price at time $t-1$, respectively, while ln symbolizes the natural log.

To check whether a time series is stationary or nonstationary, augmented Dickey–Fuller (ADF) and Phillips and Perron (PP) unit root test have been used. We use the PP unit root test also to estimate the proper result because it does heteroscedasticity and autocorrelation consistency correction to ADF test statistics. To test heteroscedasticity errors PP test is preferred the most. The ADF test is based on the estimate of the following regression:

$$\Delta Y_t = \alpha_0 + \gamma_1 y_{t-1} + \sum_{i=1}^{p} \beta_i \Delta y_{t-i} + \varepsilon_t. \tag{2}$$

Here, Δ represents first difference operator, p symbolized lag, α_0 represents constant, γ_1 and β_i are parameters, and ε_t denotes a

stochastic error term. If $\gamma = 0$, then the series is said that it is a unit root and nonstationary.

ADF test add lagged difference term of the regression to take care of possible serial correlation in the error term. On the other hand, PP use nonparametric serial correlation method to take care of serial correlation in the error term without adding lagged difference term (Gujrati, 2016). For this reason, PP test can be considered more advantageous than ADF test.

The PP test is based on the estimate of the following regression:

$$\Delta Y_t = \alpha + \rho y_{t-1} + \mathcal{E}_t. \qquad (3)$$

Here, α symbolizes constant, ρ represents parameter, and $\mathcal{E}_t$ denotes residual.

To analyze the effect of COVID-19 on the stock market volatility GJR GARCH model is used. The GJR GARCH model developed by Glosten et al. (1993) and Zakoian (1994) is used to capture asymmetric in terms of negative and positive shocks in the financial decision. One of the limitations of the GARCH model is that this model imposes a symmetric volatility response to positive and negative shocks (Sakthivel et al., 2014). This is due to the reason that conditional variance in Equation (4) is the magnitude of the lagged residuals and therefore does not account for their sign.

This asymmetric response of conditional volatility to information can be captured by including, along with the standard GARCH variables, squared values of ε_{t-1} when ε_{t-1} negative (Glosten et al., 1993). The GJR GARCH model is estimated as follows:

$$h_t = \alpha_0 + \sum_{j=1}^{q} \alpha_1 \mathcal{E}^2_{t-1} + \sum_{i=1}^{p} \beta_1 h_{t-1} + \sum_{k=1}^{r} \gamma_i l_{t-1} \mathcal{E}^2_{t-1}, \qquad (4)$$

where $l_{t-1} = 1$ if $\mathcal{E}_{t-1} < 0$; $=0$ otherwise.

γ is known as asymmetry or leverage term. If $\gamma > 0$ represents asymmetry while $\gamma = 0$ represents symmetry. The condition for non-negativity would now be $\alpha_0 \geq 0$, $\alpha_1 \geq 0$, $\beta_1 \geq 0$, and $\alpha_1 + \gamma_1 \geq 0$. In the model, the good news ($\varepsilon_{t-1} > 0$) and bad news ($\varepsilon_{t-1} < 0$) have contrasting impacts on the conditional variance, good news has an effect of β_1, while bad news has an effect of $\alpha_1 + \gamma_1$. If $\gamma_1 > 0$, negative shocks tend to have more volatility and is known as the leverage effect of the ith order. If $\gamma_1 = 0$, the news effect is symmetric.

A dummy variable is introduced in the conditional mean and variance equation to investigate the impact of the COVID-19 outbreak on the volatility of NSE and BSE. The model modified as per the GJR GARCH approach is specified as:

$$P_t = \alpha 0 + \beta_1 P_{t-1} + \gamma_1 D_1 + \mathcal{E}_1, \qquad (5)$$

$$h_t = \alpha_0 + \sum_{j=1}^{q} \alpha_1 \mathcal{E}^2_{t-1} + \sum_{i=1}^{p} \beta_1 h_{t-1} + \sum_{k=1}^{r} \gamma_i l_{t-1} \mathcal{E}^2_{t-1} + \lambda_1 D_1. \qquad (6)$$

The dummy variable D_1 assumes the value 0 for the pre-COVID-19 era and 1 for the during COVID-19 era. A negative and statistically significant coefficient for the dummy variable implies that

the COVID-19 pandemic caused a reduction in the volatility of the Indian stock market. A positive and statistically significant coefficient for the dummy variable implies that the COVID-19 crisis has caused an increase in the volatility of the Indian stock market.

4 | DISCUSSION AND ANALYSIS

This paper uses the daily price and return of two stock indices of India, BSE, and NSE. First and foremost, we calculate the descriptive statistics of the price and return of the BSE and NSE series. In Table 1, the mean return which is a major indicator of profit shows a negative value, indicating a loss in stock. Negatively skewed return with higher kurtosis value indicates chances of high losses in both the stock markets. Likewise, the return of pre-COVID-19 and during COVID-19 is presented in Table 2. As India reported the first case of COVID-19 on January 30, 2020, before this period is considered to be as the pre-COVID-19 era and the period after January 30, 2020 is considered as the during COVID-19 period for the study. In Table 2, it is observed that the mean return of both the indices is positive in the pre-COVID-19 era but daily mean returns are negative during the COVID-19 era, implying an adverse impact on stock returns. The SD of the indices has increased during the COVID-19 era which implies that the volatility of the indices has increased during the COVID-19 time frame.

Figures 1 and 2 represent the time plot of BSE and NSE stock prices respectively over the examined period. Before February 2020 (pre-COVID-19 period) the prices of both the indices are positive and show almost a smooth line in the figure. But after reporting the first case in India as well as the declaration of the first lockdown, it moves down to the bottom of the steep at the end of March 2020. From April 2020, it again shows a positive trend. This is because relaxation has been adopted in the case of a lockdown policy from April by the government.

Figures 3 and 4 present the log return of BSE and NSE from the period September 3, 2019 to July 10, 2020 and evidence of volatility is shown with the help of these two diagrams. The result depicts that BSE is more volatile than NSE. As we all know that BSE is the largest stock exchange in India, a huge number of investors from different parts of the world make investment in this market. So in terms of volatility BSE is more sensitive in comparison to NSE.

To check the stationarity of two indices, BSE and NSE, we perform ADF and PP stationarity tests. The result presented in Table 3 revealed that most of the log indices are nonstationary in level form, hence the null hypothesis is accepted. Although, log indices have been found stationary in the first difference in both ADF and PP tests. Consequently, the indices are found stationary in first deference. Therefore, the unit root tests justify the existence of stationarity at the first difference.

Table 4 presents the estimated results on the GJR GARCH (1,1) model with BSE Sensex and from this table, it has been observed that the coefficient of asymmetric (λ_1) and GARCH (β_1) are significant. The coefficient of ARCH (α_1) is found negative but significant; this particular finding indicates the existence of the ARCH effect in the BSE Sensex

TABLE 1 Descriptive statistics of the entire sample

| | BSE Sensex | NSE Nifty | | |
	Price	Return	Price	Return
Observation	209	208	209	208
Mean	466.9311	−0.000113	10,879.09	−5.78E-06
Median	496.5000	−0.000139	11,303.30	0.0004
Maximum	573.6500	0.039111	12,362.30	0.0364
Minimum	283.3000	−0.043645	7,610.250	−0.0603
SD	77.23121	0.011278	1,269.041	0.00929
Skewness	−0.708423	−0.95679	−0.63336	−1.53543
Kurtosis	2.349923	5.285872	2.083647	14.15163
JB	21.16169	45.60252	21.28587	1,159.505

Abbreviations: BSE, Bombay Stock Exchange; NSE, National Stock Exchange.
Source: Author's calculation.

TABLE 2 Descriptive statistics of stock return of pre-COVID-19 and during COVID-19 period

| | BSE Sensex | NSE Nifty | | |
	Pre-COVID-19 era	During COVID-19 era	Pre-COVID-19 era	During COVID-19 era
Mean	8.84E-05	−0.000239	0.000471	−0.000448
Median	−0.000306	0.000217	0.000455	2.95E-05
Maximum	0.020004	0.039111	0.022507	0.036482
Minimum	−0.015436	−0.043645	−0.008378	−0.060383
SD	0.006570	0.014427	0.003938	0.012348
Skewness	0.307638	−0.097568	1.844912	−1.229302
Kurtosis	3.643217	3.72661	12.00168	8.530320
JB	3.268177	2.491638	394.3503	168.8313

Abbreviations: BSE, Bombay Stock Exchange; NSE, National Stock Exchange.
Source: Author's calculation.

series. Further, the coefficient of GARCH was appeared positive and significant, which implies that volatility clustering was present in the BSE index. The positive and significant asymmetric effect also indicate the presence of asymmetric effect and this implies that negative shocks news tend to increase volatility more than positive shocks. To capture volatility, a dummy variable (D_1) has been added in both mean and variance equation; D_1 takes the value of 0 and 1 for the pre and during the COVID-19 era, respectively. The result exhibits that the coefficient of the dummy variable for BSE Sensex in the mean equation is negative but not significant. Conversely, in the variance equation, it is positive and significant. This inferred that the spot market volatility in the BSE stock market has increased during the COVID-19 period.

Table 5 presents the result of GJR GARCH with NSE Nifty. The table reveals that the coefficient of asymmetric (λ_1) and GARCH (β_1) are significant and positive, which entailed that volatility is present in NSE Nifty. The positive and significant value of the asymmetric term (λ_1) represent that negative shocks have a larger effect than the positive shock to the volatility of the NSE stock exchange. However, the coefficient of ARCH is positive but insignificant; indicating that past news does not impact current volatility. On the other hand, it can be noticed

that the coefficient of dummy variable (D_1) in the mean equation is negative but in variance, it is positive and insignificant. In both equations the coefficient of the dummy is insignificant, implying no significant impact of the COVID-19 period on the volatility of NSE stock price.

4.1 | Diagnostic measure

Ljung-Box Q and ARCH LM test is used to check the serial correlation and heteroscedasticity in the square of standardized residuals of the model. The result indicates that there is an absence of serial correlation and heteroscedasticity which is shown in Table 6. All the models performed correctly in this study.

5 | CONCLUSION AND POLICY SUGGESTION

In this study, we investigate the effect of COVID-19 on the performance of BSE and NSE; the two stock markets of India. GJH

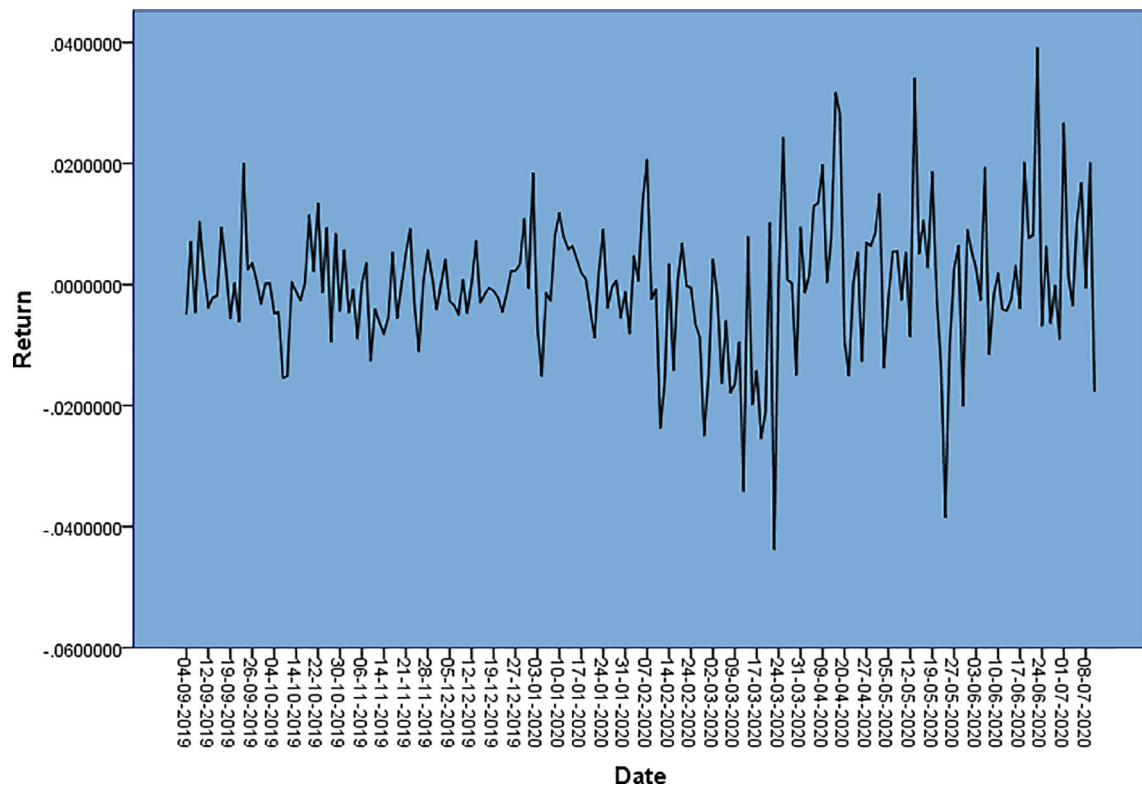**FIGURE 1**   Time plot of Bombay Stock Exchange (BSE) stock price
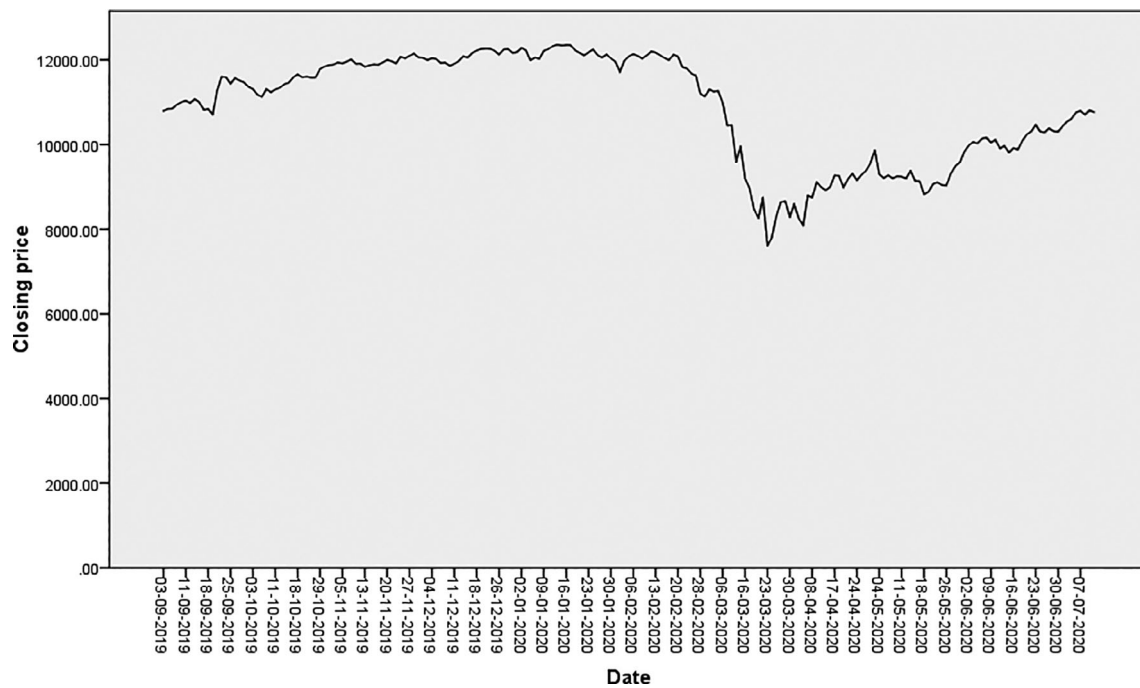
FIGURE 2   Time plot of National Stock Exchange (NSE) stock price

GARCH model is used to test the volatility in the stock market by taking the two time periods, before and after the first positive COVID-19 cases in India. These two periods are taken as the dependent variable and per day closing price of BSE and NSE indices are considered as the independent variable. The result shows that the stock market especially the BSE Sensex become volatile during the pandemic period. In case of another stock index, NSE Nifty, it is found that there is no such significant

FIGURE 3 Log return of Bombay Stock Exchange (BSE)
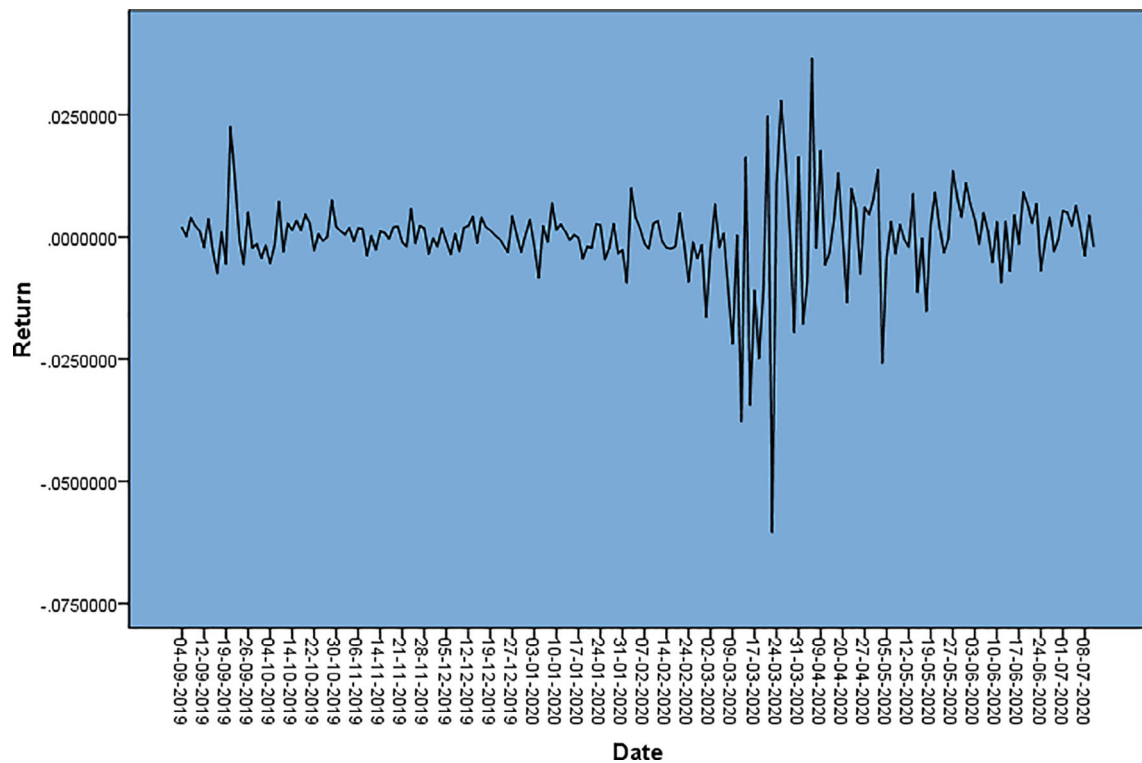
FIGURE 4 Log return of National Stock Exchange (NSE)

TABLE 3 Result of unit root statistics

Name of index	ADF in level	ADF in first difference	PP in level	PP in first difference
BSE Sensex	−1.269416 (0.6438)	−12.24932* (0.0000)	−1.456996 (0.5535)	−12.64598* (0.0000)
NSE Nifty	−1.619650 (0.4707)	−16.60469* (0.0000)	−1.220566 (0.6657)	−16.43414* (0.0000)

Abbreviations: ADF, augmented Dickey–Fuller; BSE, Bombay Stock Exchange; NSE, National Stock Exchange; PP, Phillips and Perron.
*Indicates 1% significance level.
Source: Author's calculation.

TABLE 4 Result of GJR GARCH model with BSE Sensex

Mean equation parameters	Coefficients	Z-statistics	p-value
β_0	−0.001621	−1.677327	0.0935
γ_1	−0.000705	−0.235801	0.8136
Variance equation			
α_0	1.23E-05	10.86474*	0.0000
β_1	1.024974	329.0440*	0.0000
λ_1	0.040947	1.893853**	0.0542
α_1	−0.089238	10.86474*	0.0000
δ_2	4.16E-05	4.248481*	0.0000

Abbreviations: BSE, Bombay Stock Exchange; GJR GARCH, Glosten–Jagannathan–Runkle generalized autoregressive conditional heteroscedasticity.
*Indicates 1% significance level.
**Indicates 5% significance level.
Source: Author's calculation.

TABLE 5 Result of GJR GARCH model with NSE Nifty

Mean equation parameters	Coefficients	Z-statistics	p-value
β_0	0.000659	0.983215	0.3255
γ_1	−0.000945	−0.526764	0.5984
Variance equation			
α_0	2.82E-06	1.687363	0.0915
β_1	0.822061	30.55926*	0.0000
λ_1	0.357850	4.805764*	0.0000
α_1	0.000418	1.687363	0.9887
δ_2	7.83E-06	1.070103	0.2846

Abbreviations: GJR GARCH, Glosten–Jagannathan–Runkle generalized autoregressive conditional heteroscedasticity; NSE, National Stock Exchange.
*Indicates 1% significance level.
Source: Author's calculation.

TABLE 6 Diagnostic parameters

Variable	Serial correlation		Heteroscedasticity	
	Q statistics	p-value	F statistics	p-value
BSE Sensex	30.760	0.716	0.278137	0.8919
NSE Nifty	23.924	0.938	0.161734	0.9575

Abbreviations: BSE, Bombay Stock Exchange; NSE, National Stock Exchange.
Source: Author's calculation.

large during the COVID-19 era than the pre-COVID-19 time. Similarly, the price of the stock indices also shows a significant change. In the pre-COVID-19 period, the price was high but during the COVID-19 period it shows a declining trend up to the first lockdown period, that is, to the end of March but after this, it again takes an upward movement gradually. It is on account of the relaxation added to the lockdown policy by the Indian government. The unprecedented pandemic has already brought challenges to almost all countries. Not a single sector is left unaffected because of COVID-19. In brief, the results conclude that the Coronavirus outbreak has affected the stock price and increased the volatility in the Indian stock markets, and affect the financial system. Accordingly, this paper tries to provide a very simple but original statistical analysis of the COVID-19 pandemic by taking the case of the Indian stock market.

COVID-19 has collapsed the backbone of the financial market. To boost up the stock market proper policy measures must have to be adopted by the government. Without some extraordinary policy support, the crisis would have been the worst. Accordingly, liquidity injection measures need to be taken. Reserve bank of India (RBI), the central monetary authority has cut its key policy rate by 115 basis points over the last 3 months. It also announced a liquidity injection of around Rs 8 lakh crore in the financial markets since its first announcement on March 27, 2020. Although this pandemic brings the entire world to lockdown trauma, the fatality rate is very low. Many investors can feel that this will be a short-run phenomenon and when the economy recovers it will be difficult for them to buy stocks at the current prices. According to George (2020), during this recovery period liquidity will push stock prices up. This turmoil is a good opportunity for long term investors. For debt markets, RBI must have to cut the rate. There prevails uncertainty in the market at this time. So the investors

impact of the COVID-19 period on the volatility of NSE stock prices. The mean return in pre-COVID-19 and during the COVID-19 period is calculated separately. The result revealed that with negative mean returns, the stock market faces losses during the pandemic, whereas return is shown positive in the pre-COVID-19 phase. By comparing the *SD*, it is noticed that the deviation is

must have to shift their investment from a bleak prospect to the bright one to balance their work and avoid risk. In this aspect, the pharma sector is looking attractive at this time. To maintain inclusive and sustainable growth domestic policies will need to be designed. Financial assistance must have to be provided by the supreme authority to the destroyed required sectors.

DATA AVAILABILITY STATEMENT

The data set is available on request.

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REFERENCES

Ahmed, S., Hoek, J., Kamin, S., Smith, B., & Yoldas, E. (2020). The impact of COVID-19 on emerging markets economies' financial conditions. *FEDS Notes* Retrieved from, *2020*. https://www.federalreserve.gov/econres/notes/feds-notes/the-impact-of-covid-19-on-emerging-markets-economies-financial-conditions-20201007.htm

Azimili, A. (2020). The impact of COVID-19 on the degree of dependence and structure of risk-return relationship: A quintile regression approach. *Finance Reseach Letters*. https://doi.org/10.1016/j.frl.2020.101648

Baker, S.R. Nicholas Bloom, Steven J. Davis, Kyle J. Kost, Marco C. Sammon & Tasaneeya Viratyosin (2020). *The unprecedented stock market impact of COVID-19*. Cambridge, England: NBER working paper no. 26945, NBER.

Baret, S. Anna Celner, Monica O'Reilly, and Mark Shilling (2020). COVID-19 potential implications for the banking and capital market sector. *Maintaining Business and Operational Resilience*. London, England: Deloitte insights.

BBC News, (2020). Coronavirus: FTSE 100, Dow, S&P 500 in worst day since 1987. *BBC News*, UK: BBC News.

Cepoi, C. O. (2020). Assymetric dependence between stock market returns ad news during Covid-19 financial turmoil. *Finance Research Letters*, *36*, 101658. https://doi.org/10.1016/j.frl.2020.101658

Firzli, M. N. (2020). Retrieved from https://en.wikipedia.org/wiki/Financial_market_impact_of_the_COVID-19_pandemic

Frankel, J. (2020). Pandemic pain of emerging markets. *Financial Express*. Uttar Pradesh, India: Indian Express. Retrieved from https://www.financialexpress.com/opinion/pandemic-pain-of-emerging-markets/2051195/

George, C.J. (2020). Room for further cuts in interest rates and limited, but well thought out, monetization of the deficit. Indian express.com

Georgieva, K. (2020). IMF Managing Director Kristalina Georgieva's statement following a G20 Ministerial Call on the coronavirus emergency.

Glosten, L., Jagannathan, R., & Runkle, D. (1993). On the relation between expected value and the volatility of the nominal excess return on stocks. *Journal of Finance*, *48*, 1779–1801. https://doi.org/10.1111/j.1540-6261.1993.tb05128.x

Goldberg, P. K., & Reed, T. (2020). The effect of the coronavirus pandemic in emerging market and developing economies an optimistic preliminary account. *BROOKINGS*. Washington, DC: Brookings. Retrieved from https://www.brookings.edu/bpea-articles/the-effects-of-the-coronavirus-pandemic-in-emerging-market-and-developing-economies/

Gujrati, D. N. (2016). *Basic Econometrics*. New York, NY: McGraw Hill Books Co.

Herrero, A.G. (2020). Covid-19 & Emerging Economies: What to expect in the short and medium-term. *Global economic and Governance*. New Delhi: Observer research foundation. https://www.bruegel.org/2020/06/covid-19-and-emerging-economies-what-to-expect-in-the-short-and-medium-term/.

Hyun-Jung, B. (2020). S. Korea's economy faces tipping point as COVID-19 pandemic persists. *The jakarta post* Seoul, South Korea: The Korea Herald/Asian Networks.

Igwe, P. A. (2020). Corona virus with looming global health and economic doom. *African Development Institute of Research Methodology*, *1*(1), 1–6.

Leduc, S., & Liu, Z. (2020). The uncertainty channel of the corona virus. *FRBSF Economic Letter*.

Mandal, S. (2020). *Impact of Covid-19 on Indian stock market*. Adamas University.

Osagie, M., Maijamaa, A. B. and John, D.O. (2020). On the effect of COVID-19 outbreak on the Nigerian stock exchange performance: Evidence from GARCH models. doi:https://doi.org/10.20944/preprints202004.0444.v1

Ozili, P., & Arun, T. (2020). Spillover of COVID-19: Impact on the global economy. *Munich Personal RePEc Archive*. MPRA paper no. 99850. https://mpra.ub.uni-muenchen.de/99850/.

Raja Ram, A. (2020). COVID-19 and stock market crash. *Outlook Money*. New Delhi, India: Outlook.

Rakshit, B., & Basistha, D. (2020). Can India stay immune enough to combat COVID-19 pandemic? An economic query. *Journal of Public Affairs*, 1–7. https://doi.org/10.1002/pa.2157

R Ravi. (2020). Impact of COVID-19 on Indian stock market. *BW Businessworld*. New Delhi, India: ABP Group. http://www.businessworld.in/article/Impact-Of-COVID-19-On-The-Indian-Stock-Markets/11-05-2020-191755/.

Retrieved from https://in.finance.yahoo.com/

Retrieved from https://www.mohfw.gov.in/

Retrieved from https://www.statista.com/

Sakthivel, P., Kumar, K. V., Raghuram, G., Govindaranjan, K., & Anand, V. V. (2014). Impact of global financial crisis on stock market volatility: Evidence from India. *Asian Social Science*, *10*(10), 86–94.

Shehzad, K., Xiaoxing, L., & Kazouz, H. (2020). COVID-19's disaster are perlous than global financial crisis: A rumor or fact? *Financial Research Letters*, *36*, 101669. https://doi.org/10.1016/j.frl.2020.101669

So, W. (2020). Coronavirus impact on stock market South Korea 2020.

Topcu, M., & Gulal, M. S. (2020). The impact of COVID-19 on emerging stock markets. *Finance Research Letter*. https://dx.doi.org/10.1016%2Fj.frl.2020.101691

Vishnoi, A. & Mookerjee, I. (2020). Perfect storm plunges Asia stocks bear markets one by one. *Bloomberg*.

Zakoian, J. M. (1994). Threshold Heteroscedastic model. *Journal of Economic Dynamics and Control*, (18), 931–955.

Zhang, D., Hu, M., & Ji, Q. (2020). Financial markets under the global pandemic of COVID-19. *Finance Research Letters*, *36*, 101528. https://doi.org/10.1016/j.frl.2020.101528

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